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CONCEPT LEARNING AND RELEARNING AS RELATED TO THE FREQUENCY OF SUPPORTING STIMULI

A thesis presented to the Graduate Faculty
of the Fort Hays Kansas State College in
partial fulfillment of the requirements for
the Degree of Master of Science

by

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CHAPTER I

INTRODUCTION

Although concept formation has been accorded only a minor position in psychological theory and research, concepts play such an important role in human cognition that we need to know more about factors influencing their development.

Hilgard (6) describes concepts as being words, signs, and symbols which stand for classes of objects or events, and cites their use to thinking individuals who must deal with abstract problems.

Smoke (17) defined concept formation as:

> A process whereby an organism develops a symbolic response (usually, but not necessarily, linguistic) which is made to the members of a class of stimulus patterns, but not to other stimuli.

He believed that concept formation seemed to involve groupings, and that in many instances insightful behavior was demonstrated by subjects forming these groupings. Also, Smoke thought that concepts were essential in normal everyday learning situations, and suggested that they are utilized by the higher mental processes.

From birth on, the infant is acquiring ideas and forming language concepts with which to express himself, and the process carries on indefinitely. Brownell and Hendrickson (1) state that the procucts of such learning comprise most of the

mental content of the individual, and set him apart from the members of subhuman species. They also make the point that the number of concepts taught in school is probably too large, and some of the less essential ones must be eliminated in order to assure sound learning of the concepts that are needed.

The learning and retention of concepts may have implications for psychopathology. Leeper (10) theorizes that the basic factors in personality maladjustment are not specific habits related to real experiences, but instead are more generalized concepts of how to deal with life's problems. They are possibly such things as "self-concepts" and "behavorial concepts," which if incorrectly developed may lead to definite behavior problems.

Marks and Ramond (11) found that problem-solving behavior is greatly facilitated by the formation and utilization of concepts.

Scientific research in the field of mental activities began with Ebbinghaus (3), who devised a method by which investigation of the processes and products of learning activity was made feasible. His experimentation inaugurated a flood of quantitative research upon the cognitive processes.

Fisher's (4) research attacked the problem from the viewpoint that concepts were the end-product of a mental process of generalization. Cognitive organizations which could be

utilized in thinking were the results of such activity. The technique of introspection was used by Fisher as being optimal for research into the nature of the process of generalizing facts into concepts. Later work in cognition has led to the belief that concepts are very difficult to verbalize, although they may operate functionally. This belief tends to discredit introspection as the proper method by which to study concepts.

Using sets of Chinese characters which could be categorized into similiar groupings by the recognition of common elements, Hull (9) investigated various aspects of concept formation. He concluded that the process was accomplished incidentally, and perhaps unconsciously. Hull's Chinese characters were of varying complexity and his data indicated that the more complex characters were relatively difficult to learn and verbalize. An explanation for these results was that subjects found in the more intricate characters distracting concepts which interfered with the recognition of the common elements.

Hull's study stimulated research on concept formation by objective methods, but has been criticized as being unrealistic and unlifelike. The Chinese characters used were composed of common elements, which later writers criticized as being a feature of concepts which does not exist in real life.

Heidbreder (5) hypothesized that concepts are attained

in the order of their perceptual dominance. Concepts based upon concrete objects were formed most readily, followed by concepts of form and of numbers, in that order of attainment. From her research, Heidbreder also postulated that the readiness with which any concept will be attained is directly dependent upon the degree of situational support it receives. Therefore, concepts which are suggested by many supporting stimuli will be more readily formed than concepts having lesser numbers of stimuli suggesting their formation. Dattman and Isreal (2) criticized Heidbreder's postulated order of concept attainment on the grounds that her research was not based upon types of concepts which were perceptually equal in their form of presentation. This criticism was supported by the results of an experiment conducted by Dattman and Isreal. They presented subjects with material containing stimuli which supported the formation of concepts varying in abstractness. The results indicated no significant differences in the order of attainment for the types of concepts used.

Reed (12-15) designed experiments in concept formation which could be applied more readily to everyday learning processes. He defined a concept as: "Any word or idea that stands for any one of a group of things." He used meaningless nonsense syllables to suggest such well-known concepts as colors,

animals, etc. From the results of his research, he believed conclusions could be drawn about concept formation which would be applicable to normal learning situations.

While investigating the influence of such factors as set, form of presentation, length of series, and complexity of stimuli upon concept formation and relearning, Reed found that both consistent and inconsistent types of concepts were formed. He defined consistent concepts as those which make correct responses possible in all situations, while inconsistent concepts were those which did not fit all the situations in which concepts were needed. Inconsistent concepts required more effort to develop than did consistent concepts and were not as useful as concepts which can be correctly applied to all situations.

Reed's investigation (14) of the effect of increasing the number of words from which concepts were to be formed upon concept formation and retention yielded evidence that such a variable favored the formation of inconsistent concepts and increased the amount of effort needed to form consistent concepts. The basic materials consisted of forty-two cards upon which words were printed, each card being named by one of six nonsense syllables which represented a consistent concept. The complexity of the material from which concepts were to be learned was increased by: (a) adding to the number of words

printed upon the cards, and (b) including words on the cards which favored the development of additional concepts. These additional words supported the formation of inconsistent concepts and their presence added to the subject's difficulties in forming concepts which would enable each card to be named by its proper nonsense syllable. As previously mentioned, adding to the number of words from which concepts were to be learned significantly increased the amount of effort required to form consistent concepts. When the learning material contained words which supported the formation of both consistent and inconsistent concepts, the concepts formed were learned in direct proportion to the frequency of words which suggested their formation. Varying the number of stimuli supporting competing concepts and varying the number of words presented to the subjects, did not allow an accurate estimate of the amount of interference due to each factor.

CHAPTER II

STATEMENT OF PROBLEM

This research was designed to investigate concept learning and relearning as related to the frequency of supporting stimuli. The specific problems were the following:

(1) Does the presence of stimuli supporting the formation of inconsistent concepts influence the amount of effort required to learn and relearn consistent concepts?

(2) Will concepts be learned in proportion to the number of words suggesting their formation?

(3) What are the individual differences in concept formation?

CHAPTER III

EXPERIMENTAL PROCEDURE

Subjects

The subjects for this experiment were college students enrolled in basic courses in psychology at Fort Hays State College. Thirty-six students, twenty men and sixteen women, were divided into two groups, experimental and control, and equated on the basis of their percentile rankings earned on the American College Entrance Mental Test, using Fort Hays State College norms. Only students with ACE percentile rankings between forty and seventy were used. The means and standard deviations of the ACE percentiles for the experimental and control groups were 56.8, 7.0, and 55.4, 10.1, respectively. The T score of the difference of the means was 0.48, and was not significant.

Materials

The material for the experimental group consisted of a roll of paper upon which forty lines of four words each were evenly spaced. The words were of sixth-grade difficulty and were obtained from Rinsland (16). Each line of words was directly followed by one of the nonsense syllables KUN, DAX, JIK, BEP, and YEM. The association values are: DAX, 0%;

YEM, 0%; BEP, 13%; JIK, 13%; and KUN, for which no value was listed. This information was found in Stevens (18). Each group of words was named by the nonsense syllable which followed it on the tape. Each nonsense syllable was used eight times to name the word-groups belonging to it. The order in which the nonsense syllables appeared on the tape was randomized to prevent the subjects from guessing the correct nonsense syllable from its position on the tape. Each nonsense syllable represented concepts which were suggested by some of the words belonging to that nonsense syllable. Four concepts suggested by varying numbers of words were assigned to each nonsense syllable. One of the concepts was consistent in that it was suggested by eight words, one in every line of words named by that particular concept. The other three concepts per nonsense syllable were inconsistent, being suggested by six, four, and two words, respectively. Thus the words suggesting the inconsistent concepts did not appear in all the word-groups followed by that nonsense syllable. For example: the lines of words named by the nonsense syllable KUN contained the name of one animal in each line. The concept of animal could be utilized to identify correctly all of the word-groups belonging to KUN. The concept of metal was inconsistent because only six of the word-groups followed by KUN

contained the name of a metal. Two of the word-groups followed by KUN did not contain the name of a metal. The positions of the words suggesting concepts were randomized to prevent the subjects forming concepts from position clues.

The material for the control group was similiar to that presented to the experimental group. Another tape was prepared in which the words suggesting the inconsistent concepts were removed and were replaced by words of similiar difficulty which did not support the formation of concepts. In the material presented to the control group, only one concept was assigned to each nonsense syllable, that concept being represented by eight words, one in every line. Each concept suggested by the material presented to the control group was consistent. The primary difference between the material of the two groups was that the stimuli for the control group suggested only consistent concepts, while the stimuli for the experimental group suggested both consistent and inconsistent concepts.

A Patterson memory drum was used to present the material on the tapes to the two groups of subjects. The machine was adjusted so that the subjects were allowed four seconds to observe each line of words and four seconds to observe the nonsense syllable following this line. The exposure times were identical for both groups.

In Table I the nonsense syllables and concepts of the experimental group are shown.

Procedure

Each subject was tested individually twice. During the first session the subject performed the task to a satisfactory conclusion, returned in approximately one week and performed the same task.

The following directions were given each subject in both groups:

> This is an experiment in learning concepts. A concept is a word that stands for any one of a group of things. Thus, the word bird stands for no particular bird, but for any one of a group of birds.
>
> In the window of the memory machine you will be shown a group of four words at a time. Each group of words is followed by a nonsense syllable which is the name of that group. Look carefully at the words and try to learn as soon as you can the name of each group of words and the concept it stands for. At first you will not know the names of any of the groups and you will have to depend on the machine to tell you. When the syllable appears name it aloud if you have not done so before and associate it with the group of words it follows.
>
> Your work will be finished as soon as you can name each group of words before the nonsense syllable appears in the window. Now will you answer these questions? (1) What is this an experiment in? (2) What is a concept? (3) In this experiment, is each nonsense syllable supposed to be a concept? (4) What are you to do?

After the subject had indicated his comprehension of the task, the experiment began. Each session was concluded when the subject could name all the word-groups through one

TABLE I

FREQUENCY OF STIMULI SUGGESTING CONCEPTS IN THE MATERIAL PRESENTED TO THE EXPERIMENTAL GROUP

Nonsense Syllable	Number of Supporting Stimuli Per Concept			
	8	6	4	2
BEP	vegetable	facial feature	sport	geometrical figure
JIK	tree	occupation	season	dish
KUN	animal	metal	disease	number
DAX	color	clothing	coin	liquor
YEM	flower	body of water	furniture	direction

trial without any promptings. A trial was defined as one complete presentation of the material, and a prompting was defined as each time the subject either failed to name a line of words or named a line of words incorrectly.

During the learning session for both groups, the machine was stopped at the end of the second trial and at the end of each subsequent trial. The subject then was asked: What does KUN suggest to you? This question was repeated for each of the remaining nonsense syllables. After the final trials of the learning sessions of both groups, the subjects were asked: How did you form these concepts?

During the relearning session for both groups, the machine was stopped at the end of the first trial and at the end of each subsequent trial, again the subject was asked what each nonsense syllable suggested to him.

The subject's response to each line of words, amount of time spent in the testing session, the subject's explanation of the method utilized to form concepts, and the concepts formed during the sessions were recorded during each session.

CHAPTER IV

RESULTS

1. The effect of presence of stimuli supporting the formation of competing concepts upon the amount of effort required to learn and relearn the concepts. The amount of time required in each session and the number of promptings recorded in each session were used as appropriate criteria of the amount of effort necessary to learn and relearn concepts. Table II presents the mean time and promptings per concept required to learn the concepts.

Learning and relearning concepts, when the material supported the formation of competing concepts, took significantly more time than when concepts were learned and relearned without the distracting influence of such stimuli. No significant difference between the two groups of subjects in the number of promptings required to learn and relearn consistent concepts was determined.

The number of promptings would seem to be a more accurate criterion of the amount of effort expended to learn and relearn the concepts than the amount of time required to learn and relearn them. The subject had finished his task when no promptings were needed during one complete trial. Often the subject had formed the concepts, but would

TABLE II

MEAN TIME AND PROMPTINGS PER CONCEPT REQUIRED TO LEARN AND RELEARN CONCEPTS

(N for experimental group = 19, N for control group = 17)

	Learning			
	Mean Time Per Concept (Min.)	S.D.	Mean Promptings Per Concept	S.D.
Experimental Group	13.5	3.69	18.8	8.27
Control Group	10.6	2.62	15.0	6.85
Difference	2.9		3.8	
Difference		1.06		2.52
T score	2.74**		1.51	
	Relearning			
	Mean Time Per Concept (Min.)	S.D.	Mean Promptings Per Concept	S.D.
Experimental Group	5.4	1.99	1.4	1.81
Control Group	4.2	1.50	0.6	0.75
Difference	1.2		0.8	
Difference		0.58		0.45
T score	2.07*		1.78	

* Significant at 5% Level of Confidence.
** Significant at 1% Level of Confidence.

become confused as to which concept he had formed for a particular nonsense syllable and would make an incorrect response. Because of one mistake, the subject would be required to go through an entire additional trial to conclude the session. Thus the amount of time was increased disproportionally in relation to the number of promptings. The subjects displayed a tendency to become momentarily confused and make an error when naming the word-groups. Subjects in the experimental group made more errors than subjects in the control group. This can possibly be explained by the fact that they may have learned several concepts for each nonsense syllable before finally deciding which concept was functionally most successful. They could associate an incorrect concept with the nonsense syllable more readily than could the subjects of the control group, who had no distracting stimuli to confuse them.

Due to the nature of this experimental design, the amount of time per session was not considered as accurate an index of the amount of effort as the number of promptings per session. However, even when number of promptings is used as an index of effort, the presence of stimuli supporting the formation of competing concepts does appear to increase the amount of effort required in learning and relearning.

The difference between the two groups in number of

promptings required is significant at the 15% level of confidence.

2. The relation of frequency of supporting stimuli to number of concepts learned and relearned. Table III presents the number of concepts formed with respect to the number of stimuli supporting their formation.

Twenty words suggesting concepts were present in the word-groups named by each syllable. The number of concepts expected to be formed for each frequency of supporting stimuli (8, 6, 4, 2) was calculated by multiplying the frequency of supporting stimuli divided by twenty, times the total number of concepts mentioned by the subjects in the experimental group.

In both the learning and relearning sessions, the majority of concepts mentioned were those which were consistent, that is, had a total of eight words suggesting their formation. The number of concepts mentioned which had a total of six words supporting their formation does not differ greatly from the number of concepts mentioned which had a total of four words suggesting their formation. Those concepts which were suggested by a total of two words were only infrequently learned or relearned, thus the concepts formed by the experimental group were not mentioned in proportion to the number of stimuli supporting their

TABLE III

THE RELATION OF NUMBER OF CONCEPTS FORMED TO FREQUENCY OF SUPPORTING STIMULI

	Learning	
Frequency of Supporting Stimuli	Observed Number of Concepts Formed	Expected Number of Concepts Formed
8	263	145
6	53	109
4	42	72
2	4	36
	Relearning	
Frequency of Supporting Stimuli	Observed Number of Concepts Formed	Expected Number of Concepts Formed
8	178	91
6	28	68
4	20	45
2	1	23

formation.

Hines (7) found that the formation of abstract concepts required almost twice as much effort as the formation of concrete concepts. The stimuli in this experiment supported the formation of concepts which were not completely equal in degree of abstractness. This might partially explain the tendency of subjects to form consistent concepts, as they were less abstract than many of the inconsistent concepts.

The formation of consistent concepts was rewarded when they enabled the subject to name all the word-groups correctly. When inconsistent concepts were used, not all the word-groups could be identified and consequently their use was not rewarded as regularily. This difference in regularity of reward might explain the tendency of subjects to form consistent concepts much more frequently.

3. Individual differences of the experimental group in concept formation. A variety of methods was utilized by the subjects to form the appropriate concepts. In general, the principal difference in learning techniques between subjects who formed concepts quickly and subjects who formed concepts slowly, was the presence or absence of the ability to apply their knowledge of concepts in the actual learning situation. Although every subject was asked to define a concept and the learning session did not begin until an

adequate definition was given, many subjects were not able to apply their definitions of a concept to the task.

The activity of those subjects who formed concepts quickly was characterized by a definite search for words which were similiar and could be grouped under a conceptual title. Subject No. 2 "looked for a pattern," and Subject No. 4 "looked for something related, similiar words." Subject No. 12 selected the nonsense syllable, KUN, and concentrated upon analyzing the lines of words named by KUN. This method enabled him to learn the concept quickly. Other subjects, searching for key words, observed that certain words such as cat, lion, and cow could be grouped under the concept of animal and used it successfully to name all the word-groups belonging to KUN.

A confused and somewhat passive approach to the problem was characteristic of subjects who had difficulty forming the concepts. Some looked for position clues. For example, Subject No. 11 attempted to form concepts from the second word in each line of words, an attempt which was doomed to failure. Many subjects, initially confused, guessed at the names of the word-groups and eventually perceived the relevant words.

The distracting influence of the inconsistent concepts was mentioned by Subjects No. 10, 14, and 15, who first formed

inconsistent concepts such as disease, metal, and money, and later shifted to consistent concepts which were more successful. Not all subjects who learned inconsistent concepts initially shifted to consistent concepts. Subject No. 2 first formed the concept of disease for KUN, but found that such a concept did not allow him to name all of KUN's word-groups successfully. He then shifted to metal as the correct concept for KUN. This was also unsuccessful. Finally, he assigned both concepts, disease and metal, to KUN and found that this combination enabled him to identify correctly all the lines of words named by KUN.

Another method of concept formation was demonstrated by Subject No. 18, who assigned the concept of sport to BEP. He soon realized that this concept was inadequate and finally memorized the word-groups named by BEP, which did not contain the name of a sport, Subject No. 18 then could identify correctly all the word-groups which BEP followed.

Some concepts which were not intended to be derived from the word-groups were formed by the subjects. An example of this was the concept, taxes, which Subject No. 13 of the control group formed from the word-groups named by DAX. But this subject could not formulate sufficient evidence for that concept to identify all the word-groups named by DAX. The concept, taxes, was eliminated early in the learning

session and the consistent concept, color, was formed. Concepts which are not intended to be formed from the stimuli can not be completely eliminated from any material. The degree to which these unplanned concepts were eliminated is shown by the fact that only three such concepts were mentioned by the subjects in both groups.

Some factors that seem to be involved in the aforementioned differences are: (a) differences in the ability to apply the definition of a concept to the task, (b) differences in the degree of active participation in the learning process, (c) differences in the method of attack used to solve the problem, and (d) the tendency of a few subjects to form concepts alien to the materials.

CHAPTER V

DISCUSSION

The difference between the two groups of subjects in amount of effort required to complete the task may be due to the phenomenon of inhibition. The subjects of the experimental group formed a variety of concepts before finally deciding which concepts were most useful. The concepts which were learned early in the session and then discarded would possibly tend to interfere with the process of associating the most useful concepts with the nonsense syllables. Because of interference more effort would be required to complete the task successfully.

An analysis of data relevant to the problem of whether or not concepts are formed in proportion to the frequency of supporting stimuli revealed that the majority of concepts named by subjects were the consistent concepts. Such a finding supports the law of effect, which states that information is learned in accordance with its usefulness or convenience to the organism.

The subject was given a task to perform and told that concepts could be formed from the words on the tape. He learned that forming concepts would reduce the amount of time and effort necessary to perform the task. Since a variety of

concepts could be formed, the subject had to choose among concepts. The subject usually formed the consistent concepts. These were rewarded in all cases by success in naming the word-groups correctly, but the use of inconsistent concepts was not.

The hypothesis that concrete concepts are learned more readily than abstract concepts might account for the formation of some of the consistent concepts. The consistent concepts, tree, flower, vegetable, and animal are less abstract than the inconsistent concepts, geometrical figure, number, season, and direction. Although a difference in degree of abstractness might partially account for the relatively small number of inconsistent concepts formed, the variable of abstractness would seem to have only a minor effect on the results since not all of the inconsistent concepts were more abstract than the consistent concepts.

An explanation of the results in terms of Tolman's Sign-Gestalt theory (7) would include these points: (a) learning occured when the organism was motivated by a tension-state to solve the task, (b) environmental signs were used to form a cognitive structure of the problem, (c) an expectancy was formed in accordance with the nature of the cognitive structure, and (d) the principle of least effort was demonstrated by the tendency of the subjects to form those concepts

which enabled the task to be completed with a minimum of effort.

Limitations

The limitations of this research were: (a) the small number of subjects used, (b) uneven rest periods between the learning and relearning sessions, and (c) the inadequacy of the ACE intelligence test as a means of equating the two groups.

Only thirty-six subjects participated in this research. Such a small number of subjects provided only thirty-five degrees of freedom for the statistical analysis of the data. Thus, large T scores were needed to invalidate the Null hypothesis.

An attempt was made to schedule each subject's relearning session within seven days of the learning session, but for three subjects in the experimental group, the two sessions were separated by a period of more than two weeks. This lengthy separation between learning and relearning sessions may have increased the number of promptings and amount of time required during relearning sessions for those subjects.

The task given the subjects required two processes: (a) forming a concept which would enable the word-groups to be identified correctly and then (b) associating that concept with the correct nonsense syllable.

The ACE intelligence test is probably not an adequate method with which to equate the two groups, as it is primarily an index of problem-solving ability and not associating. The groups might be equated for problem solving but not for ability to form associations.

Suggested Research

The results of this experimentation indicate the need for further research on the influence of the comparative abstractness of competing concepts upon the learning and relearning of concepts.

Concept formation as a function of frequency of supporting stimuli under the condition of equal reward for all concepts formed is another problem requiring investigation.

Application

Brownell and Hendrickson (1) believe that an excess of concepts are being taught in the present educational curriculum. They suggest that some of the concepts now being taught should be eliminated in an effort to insure that the most useful concepts are learned.

The results of this experiment indicate that the presence of stimuli supporting the formation of competing concepts may not interfere significantly with the learning and

relearning of those concepts which are most useful, provided that the use of such concepts is rewarded amply. The conclusions drawn from this research indicate that the task of educators should be not so much to reduce the number of concepts taught as to insure that the application of the most functional concepts is sufficiently rewarded to insure their formation and retention.

CHAPTER VI

SUMMARY

This research was designed to investigate concept learning and relearning as related to the frequency of supporting stimuli. The subjects were divided into control and experimental groups. The materials consisted of two rolls of paper upon which forty lines of four words each were printed. Each word-group was followed by one of five nonsense syllables which named that line of words. The paper tape which was presented to the experimental group included words suggesting a total of four concepts per nonsense syllable. The concepts were suggested by varying frequencies of stimuli. The paper tape presented to the control group included words suggesting only one concept per nonsense syllable. A Patterson memory drum was used to present the materials to the two groups. The subject's task was to name each word-group by saying the correct nonsense syllable before the memory drum turned the nonsense syllable into the subject's view. A prompting was defined as each time the subject failed to name the word-group by the correct nonsense syllable. A trial was defined as one complete presentation of the forty lines of words with the associated nonsense syllables. The subject's task was completed when he could name the word-groups through

one complete trial without any promptings. Each subject was tested twice. The first session consisted of learning the concepts. The second session was held approximately one week later to investigate the relearning of the concepts. A record was made for each subject of the number of promptings, study time, concepts formed from the material, and method of concept formation. The last data were collected for only the learning session.

The differences between the experimental and control groups for number of promptings and amount of time on the learning and relearning sessions were analyzed statistically. The number of concepts formed in relation to the frequency of supporting stimuli was noted, and the individual differences in concept formation were studied. The results were as follows:

(1) Although the presence of stimuli supporting the formation of inconsistent concepts did not significantly increase the number of promptings required to learn the consistent concepts, numerically more promptings were required by the experimental group than by the control group.

(2) The presence of stimuli supporting the formation of inconsistent concepts significantly increased the amount of time required to learn and relearn consistent

concepts.

(3) The concepts mentioned by the subjects in the experimental group did not occur in proportion to the number of stimuli supporting their formation. Concepts which were consistently supported were named almost twice as frequently as anticipated, whereas the inconsistent concepts were named much less frequently than theoretically expected.

(4) An analysis of the individual differences in concept formation revealed that the majority of subjects searched for words which were similiar and could be grouped into general categories. The formation of such categories enabled the subjects to name the word-groups correctly. Also, subjects forming concepts under the condition of competing concepts displayed little difficulty in shifting from an inconsistent concept to a consistent concept when such a move seemed necessary. This process of shifting concepts resulted in only a small increase in the number of promptings recorded, although a disproportionally greater increase in amount of time needed to complete the sessions was required.

(5) Inconsistent concepts, when unrewarded, were not a great source of interference in learning.

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APPENDIX

TABLE IV

ACE PERCENTILE RANKINGS, TOTAL PROMPTINGS, DAYS BETWEEN SESSIONS, AND TOTAL TIMES FOR SUBJECTS IN THE CONTROL GROUP

			Learning		Relearning	
Subject	ACE Percentile Score	Days Between Sessions	Total Prompt-tings	Total Time (Min.)	Total Prompt-tings	Total Time (Min.)
No.1	48	7	161	75	4	24
2	65	7	88	56	0	12
3	65	6	110	50	0	13
4	65	9	31	35	0	11
5	65	6	119	78	2	26
6	40	8	62	50	3	23
7	50	7	70	49	3	28
8	48	7	68	40	0	12
9	48	4	30	38	0	12
10	65	6	67	71	0	11
11	65	6	108	50	4	25
12	69	7	72	52	2	25
13	42	13	67	65	8	24
14	48	6	58	65	15	38
15	54	12	34	40	2	26
16	65	11	38	37	4	21
17	48	7	96	51	6	24

TABLE V

ACE PERCENTILE RANKINGS, TOTAL PROMPTINGS, DAYS BETWEEN SESSIONS, AND TOTAL TIMES FOR SUBJECTS IN THE EXPERIMENTAL GROUP

			Learning		Relearning	
Subject	ACE Percentile Score	Days Between Sessions	Total Prompt-tings	Total Time (Min.)	Total Prompt-tings	Total Time (Min.)
No.1	65	7	119	85	2	22
2	56	7	47	60	1	25
3	65	12	144	87	14	25
4	56	7	53	50	1	23
5	65	7	105	65	2	23
6	56	7	51	46	0	10
7	48	7	147	79	6	25
8	65	7	68	60	0	12
9	48	14	84	65	2	26
10	48	7	105	90	10	38
11	56	23	103	77	5	25
12	65	7	69	45	1	26
13	48	21	177	109	37	50
14	65	5	42	48	5	25
15	56	21	144	90	19	40
16	56	6	109	62	13	37
17	65	7	55	40	0	13
18	48	7	131	70	14	40
19	48	5	32	52	1	26

TABLE VI

NUMBER OF TIMES CONCEPTS WERE MENTIONED

Concepts	Learning Sessions	Relearning Sessions
vegetable	49	34
facial feature	6	3
sport	23	11
geometrical figure	0	0
tree	48	36
occupation	18	6
season	1	2
dish	0	0
animal	50	32
metal	9	10
disease	13	6
number	1	0
color	59	40
clothing	6	1
coin	5	1
liquor	3	1
flower	57	36
body of water	14	8
furniture	0	0
direction	0	0
TOTAL	362	227

TABLE VII

WORD-GROUPS AND NONSENSE SYLLABLES PRESENTED TO THE CONTROL GROUP

Word-Group				Nonsense Syllable
lint	cat	braid	pace	KUN
spirit	local	lavender	surf	DAX
peas	item	chalk	river	BEP
tale	siren	cow	aunt	KUN
cottonwood	under	straight	disgust	JIK
soup	tire	fit	turnip	BEP
blue	guest	dust	odor	DAX
honeysuckle	leak	proper	neat	YEM
point	crowd	protect	cedar	JIK
horse	except	door	thing	KUN
east	lilac	in	fog	YEM
picnic	stripe	call	green	DAX
spear	oak	lunch	stone	JIK
atom	insist	label	lily	YEM
castle	beans	air	wharf	BEP
fence	odd	pine	doll	JIK
walk	purple	list	congress	DAX
tough	dog	excess	hitch	KUN
knight	strap	poppy	fast	YEM
heavy	rally	potato	fellow	BEP
tax	brown	whip	blimp	DAX
cool	table	tip	monkey	KUN
rule	roses	night	tall	YEM
fluff	eleven	maid	red	DAX
spinach	terrible	leap	ear	BEP
too	gap	sheep	pause	KUN
common	maple	fair	less	JIK
yellow	crumb	budge	health	DAX
dry	nice	tulip	pencil	YEM
would	carrot	park	rip	BEP
walnut	pest	beads	cigar	JIK
ice	check	how	beet	BEP
sour	daisy	spade	malted	YEM
sorry	polish	elm	just	JIK
lion	bomb	salt	line	KUN
spell	timid	zone	pansy	YEM
alley	before	pink	assign	DAX
bless	pop	carrot	gargle	BEP
ought	deer	tempt	wood	KUN
road	mean	press	spruce	JIK

TABLE VIII

WORD-GROUPS AND NONSENSE SYLLABLES PRESENTED TO THE EXPERIMENTAL GROUP

Word-Group				Nonsense Syllable
lint	cat	braid	iron	KUN
glove	local	lavender	penny	DAX
peas	item	chalk	basketball	BEP
silver	siren	cow	polio	KUN
cottonwood	fall	straight	disgust	JIK
chin	triangle	help	turnip	BEP
blue	stocking	break	whiskey	DAX
honeysuckle	chair	lake	neat	YEM
point	crowd	farmer	cedar	JIK
horse	copper	banana	thing	KUN
south	lilac	sea	fog	YEM
picnic	dime	call	green	DAX
cup	oak	lunch	lawyer	JIK
atom	ocean	label	lily	YEM
football	beans	lips	wharf	BEP
fence	doctor	pine	winter	JIK
walk	purple	belt	trying	DAX
tough	dog	measles	hitch	KUN
knight	strap	poppy	bed	YEM
heavy	eyes	potato	fellow	BEP
wine	brown	hat	blimp	DAX
mumps	doesn't	steel	monkey	KUN
rule	roses	north	gulf	YEM
fluff	dollar	maid	red	DAX
spinach	terrible	circle	ears	BEP
too	apple	sheep	lead	KUN
broken	maple	spring	merchant	JIK
yellow	crumb	budge	coat	DAX
bookcase	nice	tulip	pencil	YEM
would	carrot	baseball	rip	BEP
walnut	carpenter	hurried	cigar	JIK
ice	check	how	beet	BEP
sour	daisy	pond	malted	YEM
sorry	summer	elm	just	JIK
lion	bomb	malaria	line	KUN
swamp	table	zone	pansy	YEM
quarter	shoe	pink	assign	DAX
nose	tennis	carrot	gargle	BEP
ought	deer	zinc	eleven	KUN
teacher	mean	plate	spruce	JIK